WATER RESOURCES REVIEW for

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

NOVEMBER

1974

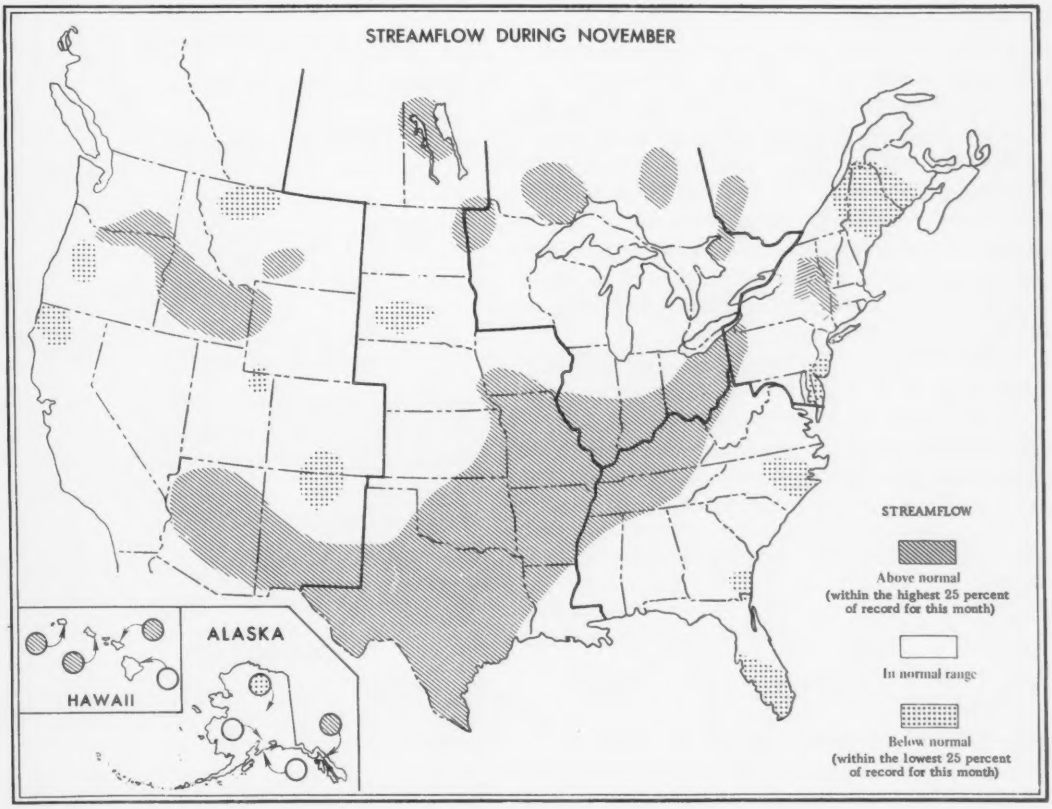
STREAMFLOW AND GROUND–WATER CONDITIONS

Streamflow increased seasonally in most of the United States other than Alaska, and in much of southern Ontario and Quebec. Flows generally decreased elsewhere in southern Canada and in parts of some western and east-central States.

Monthly mean flows remained in the above-normal range in large areas of the Columbia and Ohio River basins and in smaller areas in southern Canada, and increased into that range in a broad band across the south-central and southwestern States.

Flows were below the normal range in parts of the Atlantic Provinces, parts of some east-coastal, central, and western States, and in east-central Alaska.

Severe flash flooding occurred in parts of Kansas, Oklahoma, Texas, and Puerto Rico, and on St. Thomas and St. Croix, Virgin Islands.



NORTHEAST

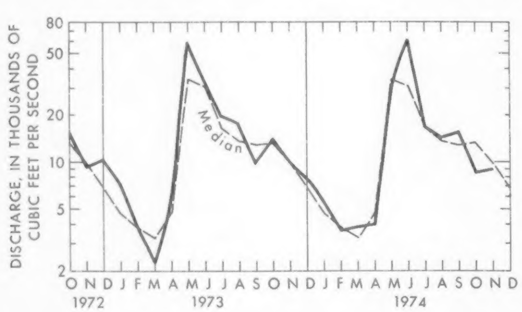
[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

STREAMFLOW INCREASED SEASONALLY IN MUCH OF THE REGION BUT DECREASED IN PARTS OF QUEBEC, THE ATLANTIC PROVINCES, AND SEVERAL OF THE EASTERN AND SOUTHERN STATES. MONTHLY MEAN FLOWS REMAINED IN THE ABOVE-NORMAL RANGE IN SOUTHWESTERN QUEBEC AND CENTRAL VERMONT, INCREASED INTO THAT RANGE IN PARTS OF NEW YORK AND PENNSYLVANIA, AND WERE BELOW THE NORMAL RANGE IN PARTS OF MAINE, MARYLAND, AND NEW JERSEY.

High carryover flows from October contributed to the continuation of above-normal monthly mean discharges on White River at West Hartford, in central Vermont, and Harricana River near Amos, in southwestern Quebec. Also, monthly mean flows of Passumpsic River at Passumpsic, Vt., Pemigewasset River at Plymouth, N.H., and White River at West Hartford, Vt., remained above median for the 19th, 13th, and 12th consecutive months, respectively.

In northwestern New York, flow of West Branch Oswegatchie River near Harrisville increased sharply and was above the normal range. Also, in northeastern Pennsylvania, flow of Oil Creek at Rouseville increased into the above-normal range and was more than 3 times the November median discharge. In the west-central part of that State, runoff from fairly heavy rain in midmonth resulted in moderate rises, without flooding, in the West Branch Susquehanna River basin.

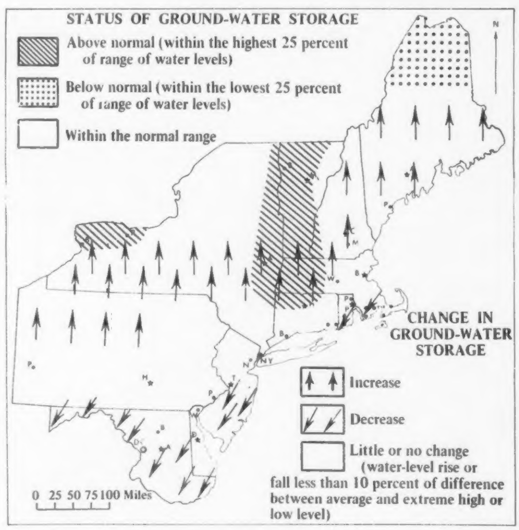
In eastern Quebec, monthly mean discharge of Outardes River at Outardes Falls decreased seasonally and was below the November median but was in the normal range (see graph). In southern New Brunswick, monthly mean flow of Lepreau River at Lepreau decreased contraseasonally into the below-normal range



Monthly mean discharge of Outardes River at Outardes Falls, Quebec (Drainage area, 7,300 sq mi; 18,900 sq km)

and was only about one half the median flow for the month. In the adjacent areas of central and northern Maine, flows at the index stations, Piscataquis River near Dover-Foxcroft and St. John River below Fish River, at Fort Kent, also were in the below-normal range and about half the respective median flows for November. Similarly, in southern New Jersey and the adjacent area of Delaware-Maryland, flows decreased contraseasonally into the below-normal range.

Ground-water levels rose in southern Maine and in much of central New England, southern New York, and northern Pennsylvania (see map). Levels declined in extreme southeastern New England and in much of Maryland, Delaware, and southern New Jersey. Month-end levels were within the normal range of levels for end of November in most of the region. Levels were above average in most of Vermont, western Massachusetts, northeastern Connecticut, and adjacent parts of New York State, as well as in the Buffalo-Rochester, N.Y., area. Levels remained below average in northern Maine.



Map above shows ground-water storage near end of November and change in ground-water storage from end of October to end of November.

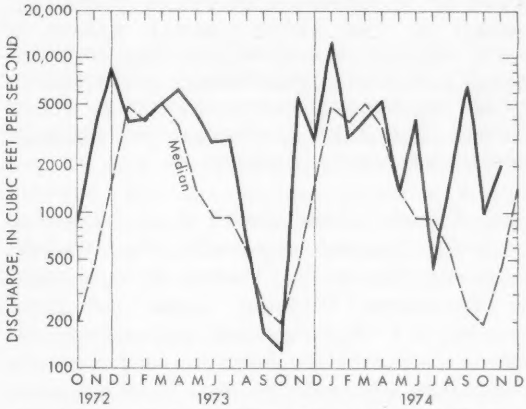
SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

STREAMFLOW DECREASED SEASONALLY IN FLORIDA BUT INCREASED SEASONALLY IN OTHER PARTS OF THE REGION EXCEPT ON THE COASTAL PLAIN OF NORTH CAROLINA AND IN SOUTHERN GEORGIA. FLOWS REMAINED IN THE BELOW-NORMAL RANGE IN WEST-CENTRAL

FLORIDA AND DECREASED INTO THAT RANGE IN SOUTHEASTERN AND SOUTHWESTERN PARTS OF THAT STATE, AND IN SOUTHEASTERN GEORGIA. IN KENTUCKY AND TENNESSEE, FLOWS REMAINED ABOVE THE NORMAL RANGE FOR THE THIRD CONSECUTIVE MONTH.

High carryover flows from October, augmented by runoff from above-normal precipitation in November, held monthly mean discharge at all index stations in Kentucky and Tennessee above the normal range for the 3d consecutive month. Flows varied from about 3 times the November median in west-central Tennessee to more than 7 times median in the north-central part of that State. Flow of Green River at Munfordville, in south-central Kentucky, increased sharply, and monthly mean discharge was more than 4 times the median for the month (see graph).



Monthly mean discharge of Green River at Munfordville, Ky.
(Drainage area, 1,673 sq mi; 4,333 sq km)

In Mississippi, flows also increased sharply at all index stations, were more than twice those of October, and were two to three times the respective November median flows.

In North Carolina, streamflow increased seasonally and was in the normal range in the western and in the central (Piedmont) parts of the State; but in the Coastal Plain, streamflow decreased contraseasonally, was only 40 percent of the November median flow, and was below the normal range.

In northeastern West Virginia, monthly mean flow at the index station, Potomac River at Paw Paw, increased slightly from the below-median flow of October, but was in the below-normal range and only 50 percent of median for the month. Similarly, in parts of eastern Virginia, flows increased slightly from those of October and were about half the November median discharges.

In southeastern Georgia, monthly mean flow of Altamaha River at Doctortown decreased into the below-normal range and remained below median for the 2d consecutive month.

Streamflow continued to decline seasonally in Florida but remained within the normal range in the northern and east-central parts of the State. In west-central Florida, flow of Peace River at Arcadia remained in the below-normal range for the 3d consecutive month and was less than half the November median. In the southeast, flow of Miami Canal at Miami decreased 143 cfs, to 92 cfs; 33 percent of normal; and in the southwest, flow southward through the Tamiami Canal outlets, 40-mile bend to Monroe, decreased 60 cfs, to 30 cfs; 14 percent of normal. In the northern part of the State, flow of Silver Springs decreased 40 cfs, to 880 cfs; 104 percent of normal. Monthly mean flows at index stations in Shoal and Suwannee River basins were 96 and 104 percent of normal, respectively.

Ground-water levels generally declined in Florida (except in southeastern part affected by heavy rains near end of month), North Carolina, the Piedmont of Georgia, and central parts of Kentucky (in shallow limestone aquifer) and West Virginia. Levels changed only slightly in coastal Georgia; and rose in Alabama, Mississippi, most of Kentucky, and in the southern one third of West Virginia. Monthend levels continued near average in North Carolina; were above average in most of Kentucky (except in shallow wells in the central part), and western West Virginia; and were below average in eastern West Virginia and in Florida (with possible exception of some wells in southeastern part).

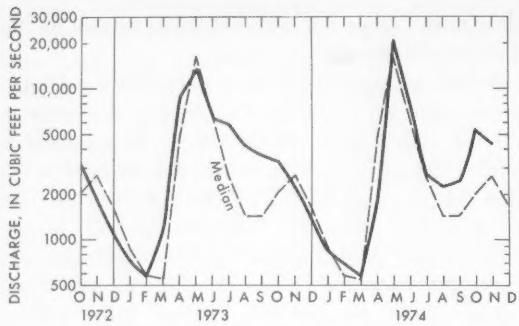
WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

STREAMFLOW DECREASED IN EAST-CENTRAL ONTARIO BUT INCREASED ELSEWHERE IN THE REGION AND REMAINED ABOVE THE NORMAL RANGE IN PARTS OF INDIANA, OHIO, AND ONTARIO. FLOWS INCREASED INTO THE ABOVE-NORMAL RANGE IN NORTHERN MICHIGAN AND SOUTHEASTERN ONTARIO, AND WERE WELL ABOVE MEDIAN IN OTHER STATES AND PROVINCES EXCEPT IN EAST-CENTRAL INDIANA.

Although flow of Missinaibi River at Mattice, in east-central Ontario, decreased contraseasonally from the unusually high flow of October, monthly mean discharge remained in the above-normal range for the 2d consecutive month and was almost twice the median flow for November (see graph on page 4).

In Michigan's Upper Peninusla, runoff from heavy precipitation during the first half of the month resulted in a sharp increase in flow of Sturgeon River near



Monthly mean discharge of Missinaibi River at Mattice, Ontario (Drainage area, 3,450 sq mi; 8,940 sq km)

Sidnaw, where monthly mean discharge was above the normal range and more than twice the November median. Similarly, in southeastern Ontario, flow of North Magnetwan River near Burk's Falls increased sharply and was in the above-normal range. Also, in southwestern Indiana, runoff from heavy rains at the beginning of the month produced flood stages along streams in the East Fork White River basin. Monthly mean discharge of East Fork White River at Shoals increased seasonally, remained above the normal range, and was more than 5 times median for the month. Monthly rainfall totals in southwestern Indiana generally were 3 to 4 times normal. In east-central Indiana, flow of Mississinewa River at Marion was slightly less than median for November.

In Ohio, flows at the two index stations increased seasonally and, augmented by high carryover flows from October, remained in the above-normal range and were nearly 3 times their respective median flows.

In nothern Illinois, flow of Pecatonica River at Freeport increased seasonally, was greater than the November median, but was not in the above-normal range where it has been in 26 of the past 28 months. Flows generally increased seasonally in Wisconsin, were greater than median, and in the normal range.

In northwestern Minnesota, high carryover flow in tributaries of Red River of the North held monthly mean flow in that stream, as measured at Grand Forks, North Dakota, in the above-normal range for the 4th consecutive month. Monthly mean discharge at that station has been in the above-normal range 20 of the past 26 months. In the south-central part of the State, flow of Minnesota River near Jordan increased contraseasonally but remained in the below-normal range and was only 45 percent of the November median flow: Cumulative runoff at that gaging station during the first two months of the 1975 water year was only 40 percent of median, in contrast to the runoff of 170 percent (of median) on Red River of the North at Grand Forks, N. Dak., during the same period.

Ground-water levels rose in most of the region, but changed only slightly in Minnesota, and continued to decline in Wisconsin. Levels near monthend were above average in most water-table wells in Ohio, Michigan, Wisconsin, and northern Minnesota; and remained below average in southern Minnesota. In wells tapping artesian aquifers underlying the Minneapolis-St. Paul, Minn., area, levels continued to rise but remained below average.

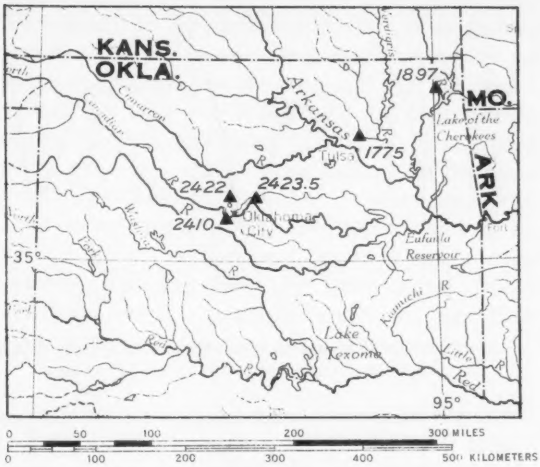
MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

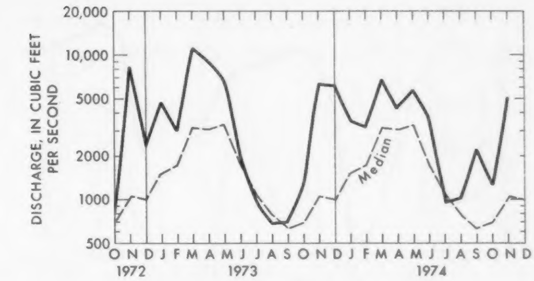
STREAMFLOW GENERALLY INCREASED THROUGHOUT THE REGION BUT DECREASED IN PARTS OF MANITOBA AND TEXAS. FLOWS REMAINED IN THE ABOVE-NORMAL RANGE IN PARTS OF MANITOBA, NORTH DAKOTA, MISSOURI, LOUISIANA, AND TEXAS, AND WERE IN THE BELOW-NORMAL RANGE IN WESTERN SOUTH DAKOTA. FLOODING OCCURRED IN PARTS OF KANSAS, OKLAHOMA, AND TEXAS.

Runoff from intense rains of 4 to 6 inches on November 1, 2, caused major flooding along tributaries of Arkansas, Cimarron, and Verdigris Rivers, in central and northeastern Oklahoma, during the period November 2–4. Peak stage and discharge data and locations of selected measurement sites are shown on the accompanying table and map. Flash flooding occurred on several streams in north-central Texas on October 30, 31, and November 1, as a result of heavy rains in that area. Similarly, runoff from intense rainfall (totaling up to 8 inches in about 6 hours) during the night of November 23–24 caused severe flash flooding on minor streams in Austin, Texas, and vicinity. Recurrence intervals of the peak discharges probably exceeded 25 years. Twelve persons drowned in the Austin area after several automobiles were swept from low-water stream crossings. In southeastern Kansas, rains that averaged more than 4 inches November 2, 3, caused serious flooding in the Verdigris, Neosho, and Marmaton River basins. Recurrence intervals for the peak discharges at most gaging stations ranged from 2 to 10 years.

High carryover flows from October held monthly mean flows in the above-normal range in some northern and southern basins in the region, and runoff from November rains expanded the areas of above-normal flow in the southern part of the region to include all of Missouri and Arkansas, most of Texas and Oklahoma,



Location of stream-gaging stations described in table of peak stages and discharges.



Monthly mean discharge of Gasconade River at Jerome, Mo. (Drainage area, 2,840 sq mi; 7, 360 sq km)

and parts of Iowa, Kansas, and Nebraska. In northwestern Missouri, and the adjacent area of southwestern Iowa, monthly mean discharge of Grand River, as measured near Gallatin, Missouri, increased sharply and was 43 times the November median. In south-central Missouri, flow also increased sharply at the index station, Gasconade River at Jerome, and was 5 times the median flow for the month (see graph). In Arkansas, Oklahoma, Texas, and northern Louisiana, monthly mean flows ranged from about 7 to about 14 times median flows at the index stations.

In south-central Manitoba, flow of Waterhen River below Waterhen Lake continued to decrease seasonally but remained in the above-normal range for the 7th consecutive month (see graph on page 6). The level of Lake Winnipeg at Gimli averaged 716.00 feet above mean sea level, 2.68 feet above the long-term November mean, and 0.41 foot lower than last month.

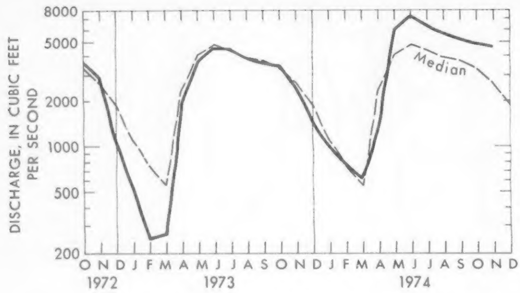
Ground-water levels rose in nearly the entire Mid-continent region; an exception was the slowly declining level in the terrace aquifer of central Louisiana. Month-end levels were again below average in North Dakota; and were near average in Nebraska except for continued below-average levels (about equal to those of 1970) in areas where large amounts of ground water are used for municipal and irrigation supplies. In Texas, levels rose in wells tapping the Edwards Limestone at San Antonio,

Provisional data; subject to revision

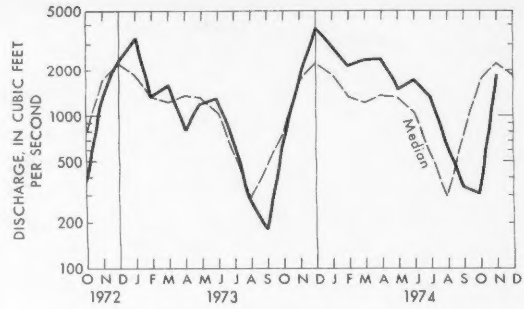
STAGES AND DISCHARGES FOR THE FLOODS OF NOVEMBER 1974 AT SELECTED SITES IN OKLAHOMA

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
ARKANSAS RIVER BASIN											
07-1775	Bird Creek near Sperry . . .	905	1938–	Oct. 3, 1959	32.60	90,000	Nov. 4	31.45	60,000	66.3	35
07-1897	Horse Creek at Afton	21.9	1966–	June 8, 1974	12.71	2,270	3	13.55	2,680	122	25
07-2410	North Canadian River below Lake Overholser, near Oklahoma City.	8,323	1923, 1952–68, 1969–	October 1923	[a]40.9	135,000	3	29.19	12,000	1.4	20
07-2422	Deep Creek at Oklahoma City.	2.98	1972–	Sept. 3, 1973	12.4	2,900	2	13.1	3,600	1,208	50
07-2423.5	Deep Fork near Arcadia . .	108	1969–	Sept. 22, 1970	19.81	5,260	3	25.6	14,300	132	40

[a]Maximum stage known (from information by State Highway Department).



Monthly mean discharge of Waterhen River below Waterhen Lake, Manitoba (Drainage area, 22,000 sq mi; 57,000 sq km)



Monthly mean discharge of Sproat River near Alberni, British Columbia (Drainage area, 134 sq mi; 347 sq km)

the Evangeline aquifer at Houston, and the bolson deposits at El Paso. Monthend levels for November were above average at Austin and San Antonio; and were lowest of record at Houston and El Paso as well as at Plainview (north Texas) in the Ogallala Formation.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

STREAMFLOW INCREASED SEASONALLY AT MOST OF THE INDEX STATIONS IN THE REGION BUT DECREASED SEASONALLY IN SOME BASINS IN THE CANADIAN PROVINCES AND THE SEVEN EASTERN STATES. MONTHLY MEAN DISCHARGES REMAINED IN THE ABOVE-NORMAL RANGE IN PARTS OF THE COLUMBIA RIVER BASIN, INCREASED INTO THAT RANGE IN LARGE AREAS OF ARIZONA AND NEW MEXICO, AND REMAINED IN THE BELOW-NORMAL RANGE IN PARTS OF CALIFORNIA, MONTANA, UTAH, COLORADO, AND NEW MEXICO.

In north-coastal British Columiba, where flow of Skeena River at Usk was highest of record in October, monthly mean discharge decreased sharply and was below median in November. On Vancouver Island, in southwestern British Columbia, monthly mean flow of Sproat River near Alberni increased sharply, from 40 percent of median in October to 109 percent of median in November (see graph).

In the Columbia River basin, high carryover flows from October in several tributaries, including the Snake and Salmon Rivers in Idaho, contributed to the above-normal monthly mean discharge during November at The Dalles, in northwestern Oregon.

In west-central Oregon, because the seasonal increase that occurred in the flow of Willamette River at Salem during November was much less than normal, November mean flow was only 58 percent of median and in the below-normal range. Similarly, in north-coastal California, low carryover flow and only a minor seasonal increase during November, held monthly mean discharge of Smith River near Crescent City in the below-normal range for the 4th consecutive month. Cumulative runoff at that index station during the first two months of the 1975 water year was only 17 percent of median. In northwestern Montana, monthly mean discharges remained in the below-normal range as a result of low carryover flows from October and below-normal runoff from precipitation during November.

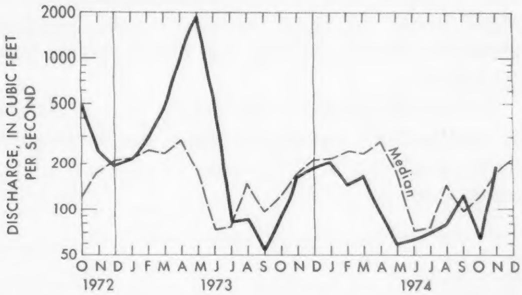
In the upper Snake River basin in eastern Idaho and the adjacent area of western Wyoming, high carryover flow from October contributed to the above-normal discharge at the index station, Snake River near Heise, Idaho, where monthly mean flows have been in the above-normal range for 13 consecutive months.

In central and eastern parts of Arizona, high carryover flows from October, augmented by runoff from above-normal precipitation in early November, resulted in monthly mean discharges in the above-normal range in those areas. For example, in the east-central part of the State, where the monthly mean flow of Little Colorado River near Cameron was more than twice the median flow in October, the mean flow during November was 32 times the median for the month. In southeastern Arizona, flow of San Pedro River at Charleston decreased seasonally, was slightly below median, and in the normal range.

In north-central New Mexico, and the adjacent area of Colorado, flow of Rio Grande, as measured at Otowi Bridge, near San Ildefonso, New Mexico, increased seasonally but remained in the below-normal range for the 6th consecutive month.

In Utah, monthly mean flows generally decreased seasonally in the north and increased seasonally in the south. At the index station, Whiterocks River near

Whiterocks, in the northeast, monthly mean discharge remained in the below-normal range for the 6th consecutive month. Also in northern Utah, the level of Great Salt Lake rose 0.20 foot during the month (to 4,199.35 feet above mean sea level), 0.05 foot higher than a year ago and 1.75 feet higher than the average (1904–72) level for November. In southeastern Utah, and the adjacent area of Arizona, monthly mean flow of Virgin River, as measured at Littlefield, Arizona, increased sharply, from the below-normal flow of October, was in the normal range, and was slightly greater than the November median (see graph).



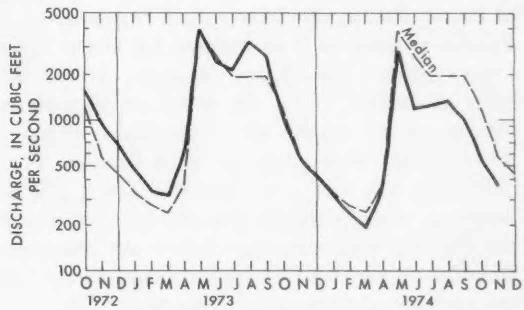
Monthly mean discharge of Virgin River at Littlefield, Ariz.
(Drainage area, 5,090 sq mi; 13,180 sq km)

Storage in major reservoirs in the region generally was above average near monthend. The net decrease in storage in the Colorado River Storage Project was 166,240 acre-feet during the month.

Ground-water levels rose in Utah (except in east), western Washington, eastern Idaho (Snake Plain aquifer in Atomic City area), north-central Nevada, and southern Arizona; changed only slightly in southern New Mexico (except for rises in the Roswell area); and declined in Montana and northern and southwestern Idaho (Athol and Meridian areas). Monthend levels were above average in Washington, most of Idaho and Nevada (except in heavily pumped areas); and were below average in Utah (except southeastern part) and southern New Mexico. Levels were lowest of record for November in the Elfrida and Avra Valley areas of southern Arizona.

ALASKA

Streamflow decreased seasonally at all index stations in the State but remained in the above-normal range in the southeast, where monthly mean discharge of Gold Creek near Juneau was twice the November median flow as a result of high carryover flow from the highest-of-record mean discharge during October, augmented by above-normal rainfall and temperatures. By contrast, flow of Chena River at Fairbanks, in east-central Alaska, remained in the below-normal range for the 6th consecutive month (see graph). Elsewhere in the State,



Monthly mean discharge of Chena River near Fairbanks, Alaska
(Drainage area, 1,980 sq mi; 5,130 sq km)

monthly mean discharges at index stations were slightly greater than the median flows for the month.

Ground-water levels in the Anchorage area rose slightly in water-table wells and declined in the artesian aquifers. Monthend levels were near average in all aquifers in the area.

HAWAII

Streamflow increased seasonally in all parts of the State and was in the above-normal range in the western and central parts—the islands of Kauai, Oahu, and Maui, in sharp contrast to the low flows of October. On the eastern island of Hawaii, where October flow at the index station was lowest for that month since records began in 1930, flow increased into the normal range. Drought conditions that have persisted for about 6 months on the islands of Maui and Hawaii were ended by above-normal rainfall during November.

PUERTO RICO AND VIRGIN ISLANDS

SEVERE FLOODING OCCURRED IN NORTHERN AND EASTERN PARTS OF PUERTO RICO NEAR MONTHEND IN OCTOBER, AND IN THE EASTERN TWO-THIRDS OF THAT ISLAND, AND ON ST. THOMAS AND ST. CROIX, VIRGIN ISLANDS, IN MID-NOVEMBER.

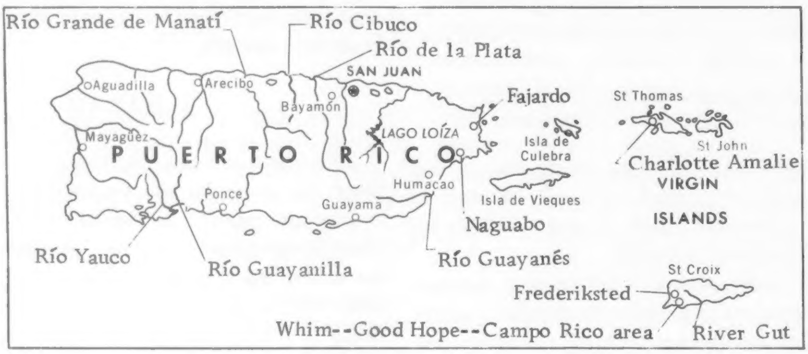
A stationary cold front caused locally heavy rains in northern and eastern Puerto Rico on October 23, 24. Rapid runoff from that storm resulted in peak discharges on Río Grande de Manatí, Río Cibuco, and Río de la Plata, equal to those that might recur on the average of once each 3 to 4 years, and a peak discharge of 14,000 cfs, October 23, on Río Fajardo near Fajardo, equivalent to that of a 10-year flood. Several hundred families were forced from their homes by the flooding.

This stagnated cold front, the first of the 1974–75 winter season, was reinforced by an upper air trough November 11, and the increased atmospheric instability resulted in rainfall of 7 inches in the eastern two-thirds of Puerto Rico in the 2-day period, November 11, 12. Rainfall amounts of 5 to 7 inches fell in the 12-hour period between 1800 hours November 11 and 0600 hours November 12 at the towns of Naguabo and Fajardo, at the eastern tip of the island. High-water measurements were made on Ríos Fajardo, Yauco, Guayanilla, and Guayanés. The Río Yauco gage was destroyed, the Río Fajardo gage was damaged severely, and the Río Guayanes gage shelter was overtopped. Runoff from Río Fajardo and Río Guayanés was 1,000 and 1,400 cfs per square mile, respectively.

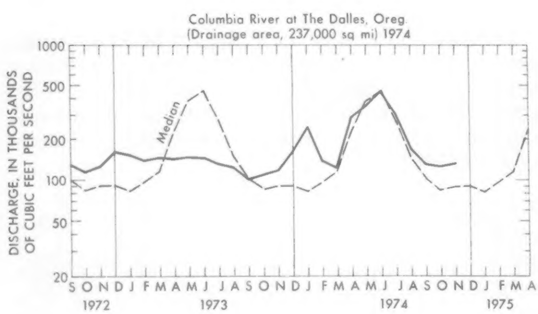
On St. Thomas, 7 inches of rain fell in the 7-hour period between 0200 hours and 0900 hours November 12, at the Dorothea Agricultural Station, in the hills just north of Charlotte Amalie (where the airport and main tourist shops are located). A total of 6 inches was observed in Charlotte Amalie during the same period. These intense rains, falling on soil already saturated from previous heavy showers, resulted in very rapid runoff and severe erosion. Large volumes of topsoil were carried into the streets, blocking drains, and resulting in flooding of many local stores. With about 18 inches of water on the runway, the airport was closed for several hours.

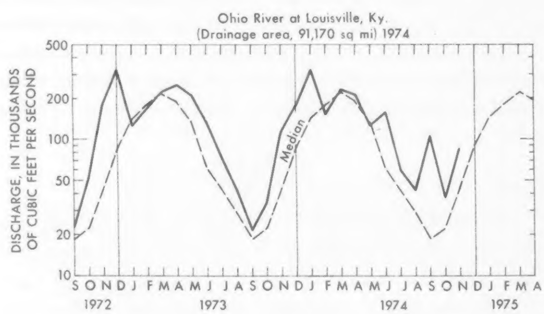
On St. Croix, where intense rains had fallen on November 5 and 8 (up to 5.5 inches in 4 hours on the 5th, and 3 inches in 2 hours on the 8th), the heavy rains of November 11, 12 (totaling 4 to 6 inches during the 2-day period) resulted in severe flooding in the lower-terrain areas of Whim, Good Hope, Campo Rico, and Frederiksted. The peak discharge November 12, on River Gut at Golden Grove, in southwestern St. Croix, was about 1,400 cfs (stage, about 13 feet); maximum previously known discharge was 850 cfs (stage, about 10.5 feet).

Ground-water levels in two former observation wells in southwestern (Adventure well) and south-central (Castle Coakley) St. Croix, rose 17 feet and 5.5 feet respectively.



HYDROGRAPHS OF TWO LARGE RIVERS





Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF NOVEMBER 1974

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Oct. 1974	End of Nov. 1974	End of Nov. 1973	Average for end of Nov.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	41	47	41	38	223,400 (a)
QUEBEC					
Gouin (P)	89	94	93	65	6,954,000 ac-ft
Allard (P)	62	66	78	58	280,600 ac-ft
MAINE					
Seven reservoir systems (MP)	51	48	68	55	178,489 mcf
NEW HAMPSHIRE					
Lake Winnipesaukee (PR)	65	71	62	55	7,200 mcf
Lake Francis (FPR)	78	80	64	78	4,326 mcf
First Connecticut Lake (P)	64	69	69	77	3,330 mcf
VERMONT					
Somerset (P)	68	73	65	69	2,500 mcf
Harriman (P)	50	44	59	64	5,060 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	69	72	63	72	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	56	60	45	55	34,270 mcf
Indian Lake (FMP)	92	87	72	57	4,500 mcf
New York City reservoir system (MW)	82	83	64	......	547,500 mg
NEW JERSEY					
Wanaque (M)	64	59	53	66	27,730 mg
PENNSYLVANIA					
Wallenpaupack (P)	55	63	49	49	6,875 mcf
Pymatuning (FMR)	92	93	77	77	8,191 mcf
MARYLAND					
Baltimore municipal system (M)	91	89	91	83	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	83	79	72	74	12,580 mcf
High Rock Lake (P)	42	37	39	55	10,230 mcf
Narrows (Badin Lake) (P)	93	94	93	92	5,616 mcf
SOUTH CAROLINA					
Lake Murray (P)	76	74	83	56	70,300 mcf
Lakes Marion and Moultrie (P)	80	86	81	60	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	61	55	65	48	75,360 mcf
GEORGIA					
Burton (PR)	87	77	61	53	104,000 ac-ft
Lake Sidney Lanier (FMPR)	55	44	53	46	1,686,000 ac-ft
Sinclair (MPR)	83	75	83	68	214,000 ac-ft
ALABAMA					
Lake Martin (P)	84	78	73	57	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	31	27	61	29	1,156,000 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	47	44	57	32	1,452,000 cfsd
Douglas Lake (FPR)	23	26	26	15	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	49	40	50	40	512,200 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	44	35	55	39	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	85	89	87	74	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	56	62	47	63	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	33	31	37	28	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	92	91	92	91	22,640,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	70	74	84	68	1,948,000 ac-ft
OKLAHOMA					
Keystone (FPR)	100	161	117	95	661,000 ac-ft
Lake O' The Cherokees (FPR)	90	112	120	80	1,492,000 ac-ft
Tenkiller Ferry (FPR)	102	148	157	97	628,200 ac-ft
Lake Altus (FIMR)	32	41	47	46	134,500 ac-ft
Eufaula (FPR)	97	123	147	87	2,378,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	101	107	117	91	2,722,000 ac-ft
TEXAS					
Possum Kingdom (IMPRW)	98	75	89	80	724,500 ac-ft
Buchanan (IMPW)	99	99	82	77	955,200 ac-ft
Bridgeport (IMW)	44	58	53	41	386,400 ac-ft
Eagle Mountain (IMW)	99	99	100	86	190,300 ac-ft
Medina Lake (I)	100	100	100	48	254,000 ac-ft
Lake Travis (FIMPRW)	100	100	100	75	1,144,000 ac-ft
Lake Kemp (IMW)	51	63	60	76	319,600 ac-ft
THE WEST					
ALBERTA					
Spray (P)	....	....	75	67	210,000 ac-ft
Lake Minnewanka (P)	....	....	84	75	199,700 ac-ft
St. Mary (I)	....	....	48	60	320,800 ac-ft
WASHINGTON					
Franklin D. Roosevelt Lake (IP)	97	98	95	96	5,232,000 ac-ft
Lake Chelan (PR)	76	63	62	64	676,100 ac-ft
IDAHO--WYOMING					
Upper Snake River (7 reservoirs) (IMP)	58	65	58	57	4,282,000 ac-ft
WYOMING					
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	59	61	71	42	3,056,200 ac-ft
Buffalo Bill (IP)	68	67	53	72	421,300 ac-ft
Boysen (FIP)	86	85	94	78	802,000 ac-ft
Keyhole (F)	69	69	79	36	199,900 ac-ft
COLORADO					
John Martin (FIR)	0	0	1	14	364,400 ac-ft
Colorado–Big Thompson project (I)	68	69	82	55	722,600 ac-ft
Taylor Park (IR)	65	55	59	52	106,000 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	73	72	71	......	31,276,500 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	78	79	79	56	1,421,000 ac-ft
CALIFORNIA					
Hetch Hetchy (MP)	63	52	63	40	360,400 ac-ft
Lake Almanor (P)	89	83	90	44	1,036,000 ac-ft
Shasta Lake (FIPR)	81	77	83	65	4,377,000 ac-ft
Millerton Lake (FI)	29	38	43	38	503,200 ac-ft
Pine Flat (FI)	46	47	50	37	1,014,000 ac-ft
Isabella (FIR)	45	41	37	19	551,800 ac-ft
Folsom (FIP)	69	65	62	49	1,000,000 ac-ft
Lake Berryessa (FIMW)	87	86	93	75	1,600,000 ac-ft
Clair Engle Lake (Lewiston) (P)	76	75	91	73	2,438,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	78	68	68	47	744,600 ac-ft
NEVADA					
Rye Patch (I)	62	60	65	......	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	74	75	77	67	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	26	26	58	12	1,093,000 ac-ft
Salt and Verde River system (IMPR)	49	51	74	33	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	37	37	72	77	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	15	16	28	25	2,539,000 ac-ft

[a] Thousands of kilowatt-hours

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 metre   1 mile = 1.609 kilometres
1 acre = 0.4047 hectare = 4,047 square metres
1 square mile (sq mi) = 259 hectares = 2.59 square kilometres (sq km)
1 acre-foot (ac-ft) = 1,233 cubic metres
1 million cubic feet (mcf) = 28,320 cubic metres
1 cubic foot per second (cfs) = 0.02832 cubic metres per second = 1.699 cubic metres per minute
1 second-foot-day (cfsd) = 2,447 cubic metres per day
1 million gallons (mg) = 3,785 cubic metres = 3.785 million litres
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic metres per minute = 3,785 cubic metres per day

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING NOVEMBER 1974

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	November 1974: Monthly discharge (cfs)	November 1974: Percent of median monthly discharge, 1941–70	November 1974: Change in discharge from previous month (percent)	Discharge near end of month (cfs)	Discharge near end of month (mgd)	Discharge near end of month: Date
1–0140	St. John River below Fish River, at Fort Kent, Maine.	5,690	9,397	3,403	48	+26	2,700	1,700	30
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	3,079	154	+188	4,200	2,700	30
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	7,400	188	+143	7,000	4,500	30
1–4635	Delaware River at Trenton, N.J	6,780	11,360	9,422	104	+12	10,600	6,900	26
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	22,350	106	+107	32,500	21,000	30
1–6465	Potomac River near Washington, D.C.	11,560	[1] 10,640	2,810	68	+7	2,910	1,900	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	1,828	79	+26	1,830	1,200	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	4,580	102	-8	2,560	1,700	26
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	3,446	74	-2	3,670	2,400	25
2–3205	Suwannee River at Branford, Fla	7,740	6,775	3,330	78	-47	2,910	1,900	30
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	9,970	90	-3	10,400	6,700	26
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	6,395	110	+85	8,600	5,600	21
2–4895	Pearl River near Bogalusa, La	6,630	8,533	4,630	272	+41	6,020	3,900	30
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 18,700	22,100	205	+172	44,400	28,700	27
3–0850	Monongahela River at Braddock, Pa.	7,337	[1] 11,950	8,450	130	+109	20,800	13,400	27
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	7,126	108	+26	11,000	7,100	25
3–2345	Scioto River at Higby, Ohio	5,131	4,337	3,201	283	+120	5,100	3,300	27
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	85,900	194	+130	135,900	87,800	25
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	26,140	348	+116	22,600	14,600	30
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[1] 6,528	4,740	136	+50	....	....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,142	2,920	103	+109	....	....	.....
4–2643.31	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	299,000	239,100	277,000	121	-9	275,000	178,000	25
050115	St. Maurice River at Grand Mere, Quebec.	16,300	24,900	28,900	140	+14	25,000	16,200	28
5–0825	Red River of the North at Grand Forks N. Dak.	30,100	2,439	2,163	190	+6	....	....	.....
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	377	45	+19	300	190	30
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[1] 10,230	7,124	132	+112	5,100	3,300	30
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	4,740	134	+108	....	....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	6,190	104	-1	....	....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	4,820	169	+15	5,400	3,500	30
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	47,053	129	+45	43,200	27,900	30
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa.	9,879	3,796	895	103	+77	469	300	30
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	4,296	119	+3	3,850	2,500	30
6–9345	Missouri River at Hermann, Mo	528,200	78,480	100,400	230	+95	52,000	33,600	25
7–2890	Mississippi River near Vicksburg, Miss.[4]	1,144,500	552,700	538,800	185	+67	636,000	411,000	25
7–3310	Washita River near Durwood, Okla ..	7,202	1,379	4,902	1,099	+536	1,740	1,100	30
8–3130	Rio Grande at Otowi Bridge, near San Ildefonso, N.Mex.	14,300	1,530	428	67	+197	....	....	.....
9–3150	Green River at Green River, Utah ...	40,600	6,369	2,534	100	+64	3,650	2,400	25
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	19,300	167	+14	25,100	16,200	25
13–2690	Snake River at Weiser, Idaho	69,200	17,670	16,690	118	+4	16,900	10,900	.....
13–3170	Salmon River at White Bird, Idaho ..	13,550	11,060	5,704	111	0	5,700	3,700	.....
13–3425	Clearwater River at Spalding, Idaho ..	9,570	15,320	7,522	139	+98	8,060	5,200	.....
14–1057	Columbia River at The Dalles, Oreg.[5]	237,000	194,000	131,300	123	+4	....	....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	16,000	58	+18	24,300	15,700	26–30
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	8,330	104	-53	....	....	.....
8MF005	Fraser River at Hope, British Columbia.	78,300	95,300	45,900	77	-33	36,700	23,700	28

[1] Adjusted.

[2] Records furnished by Corps of Engineers.

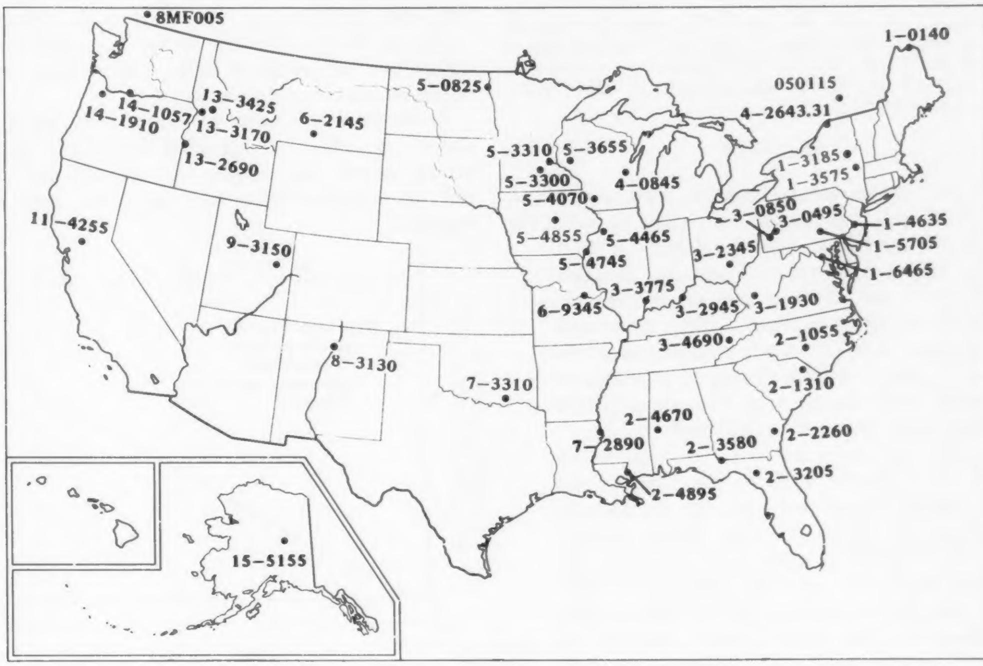
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.

[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 10.

WATER RESOURCES REVIEW — NOVEMBER 1974

Cover map shows generalized pattern of streamflow for November based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for November 1974 is compared with flow for November in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for November is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being within the *normal range*. In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the November flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of November. Water level in each key observation well is compared with average level for the end of November determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels*, unless described otherwise, are from the end of October to the end of November.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

This issue was prepared by J. C. Kammerer, H. D. Brice, T. H. Woodard, and J. K. Reid, based on reports from the field offices; copy preparation by L. C. Fleshmon and S. L. Peterson, December 6, 1974.

COST ANALYSIS OF GROUND-WATER SUPPLIES IN THE NORTH ATLANTIC REGION, 1970

The accompanying abstract and graphs are from the report, *Cost analysis of ground-water supplies in the North Atlantic Region, 1970*, by D.J. Cederstrom: U.S. Geological Survey Water-Supply Paper 2034, 48 pages, 1973; prepared in cooperation with the U.S. Army Corps of Engineers. The report may be purchased for $0.60 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (GPO Stock number 2401-02428).

ABSTRACT

The cost of municipal and industrial ground water (or, more specifically, large supplies of ground water) at the wellhead in the North Atlantic Region in 1970 generally ranged from 1.5 to 5 cents per thousand gallons (figs. 1 and 2). Water from crystalline rocks and shale is relatively expensive. Water from sandstone is less so. Costs of water from sands and gravels in glaciated areas and from Coastal Plain sediments range from moderate to very low. In carbonate rocks costs range from low to fairly high.

The cost of ground water at the wellhead is low in areas of productive aquifers, but owing to the cost of connecting pipe, costs increase significantly in multiple-well fields. In the North Atlantic Region, development of small to moderate supplies of ground water may offer favorable cost alternatives to planners, but large supplies of ground water for delivery to one point cannot generally be developed inexpensively. Well fields in the less productive aquifers may be limited by costs to 1 or 2 million gallons a day, but in the more favorable aquifers development of several tens of millions of gallons a day may be practicable and inexpensive.

Cost evaluations presented cannot be applied to any one specific well or specific site because yields of wells in any one place will depend on the local geologic and hydrologic conditions; however, with such cost adjustments as may be necessary, the methodology presented should have wide applicability. Data given show the cost of water at the wellhead based on the average yield of several wells. The cost of water delivered by a well field includes costs of connecting pipe and of wells that have the yields and spacings specified. Cost of transport of water from the well field to point of consumption and possible cost of treatment are not evaluated.

In the methodology employed, costs of drilling and testing, pumping equipment, engineering for the well field, amortization at 5-1/8 percent interest, maintenance, and cost of power are considered.

The report includes an analysis of test drilling costs leading to a production well field. The discussion shows that test drilling is a relatively low cost item and that more than a minimum of test holes in a previously unexplored area is, above all, simple insurance in keeping down costs and may easily result in final lower costs for the system.

Use of the jet drill for testing is considered short sighted and may result in higher total costs and possibly failure to discover good aquifers.

Economic development of ground water supplies will depend on obtaining qualified hydrologic and engineering advice, on carrying out adequate test drilling, and on utilizing high-quality (at times, more costly) material.

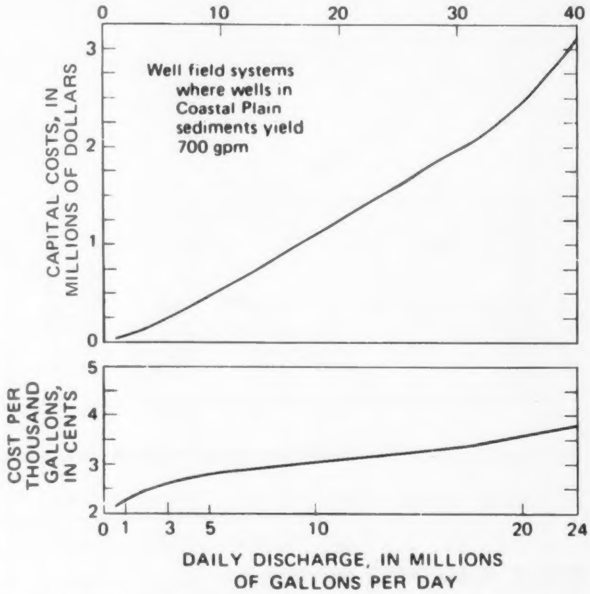


Figure 1.––Capital costs and cost per thousand gallons of water from wells in Coastal Plain sediments.

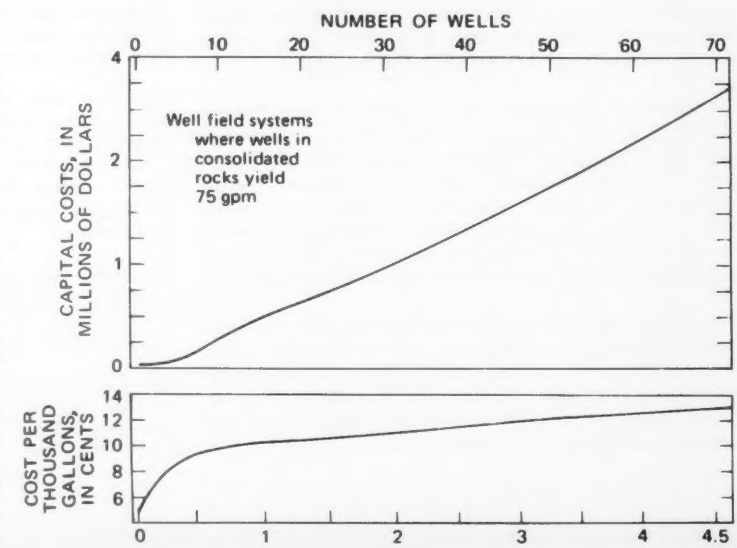


Figure 2.––Capital costs and cost per thousand gallons of water from wells in consolidated rocks.

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